



An End-to-End Approach to Physically Based Rendering

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Session: Context

- Still a lot of confusion and misunderstanding about PBR
- A lot of PBR learning material not very 'artist friendly'
- Completely new approach to the way we think about how we author our content



Session: Purpose

High-level look into:

1. Understanding PBR
2. Authoring Workflow & Guidelines
3. Troubleshooting Physically-Based Scenes
4. Q&A



1. Understanding PBR

What is PBR?

As the name suggests, physically-based rendering (PBR) is a method of shading & rendering, used in order to provide a more accurate representation of the real (physics-based) world around us.

Why bother to learn the science?

- As artists it's important for us to understand how light interacts with surfaces in order for us to be able to realistically re-create this within our own content.

Better understanding = Better content

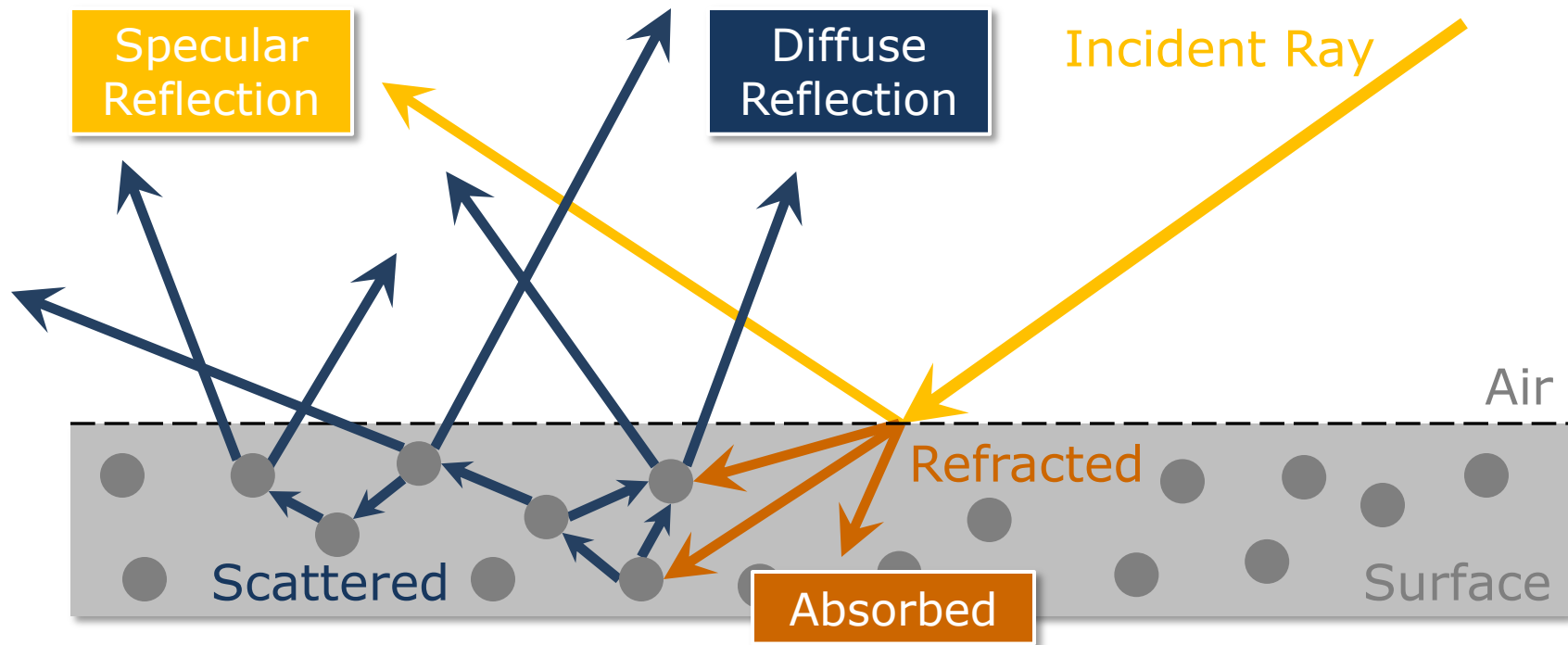


Key Concepts of PBR



1. Specular and Diffuse Reflection
2. Microfacet Theory
3. F0 Reflectance
4. Energy Conservation

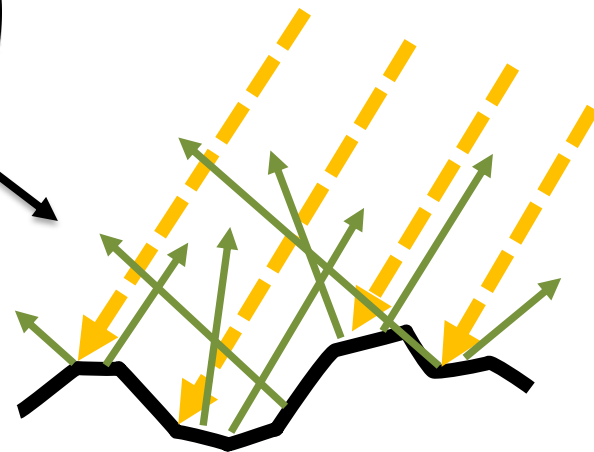
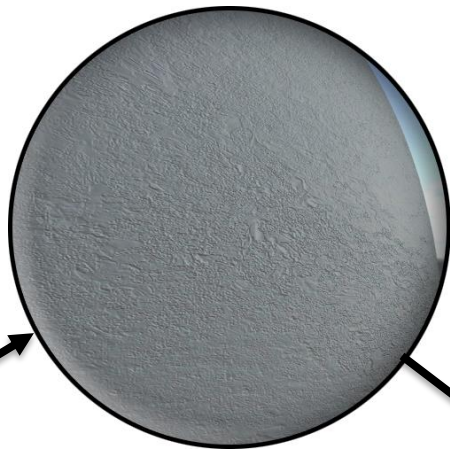
When light hits a surface



Colour



Not all surfaces are perfectly smooth!

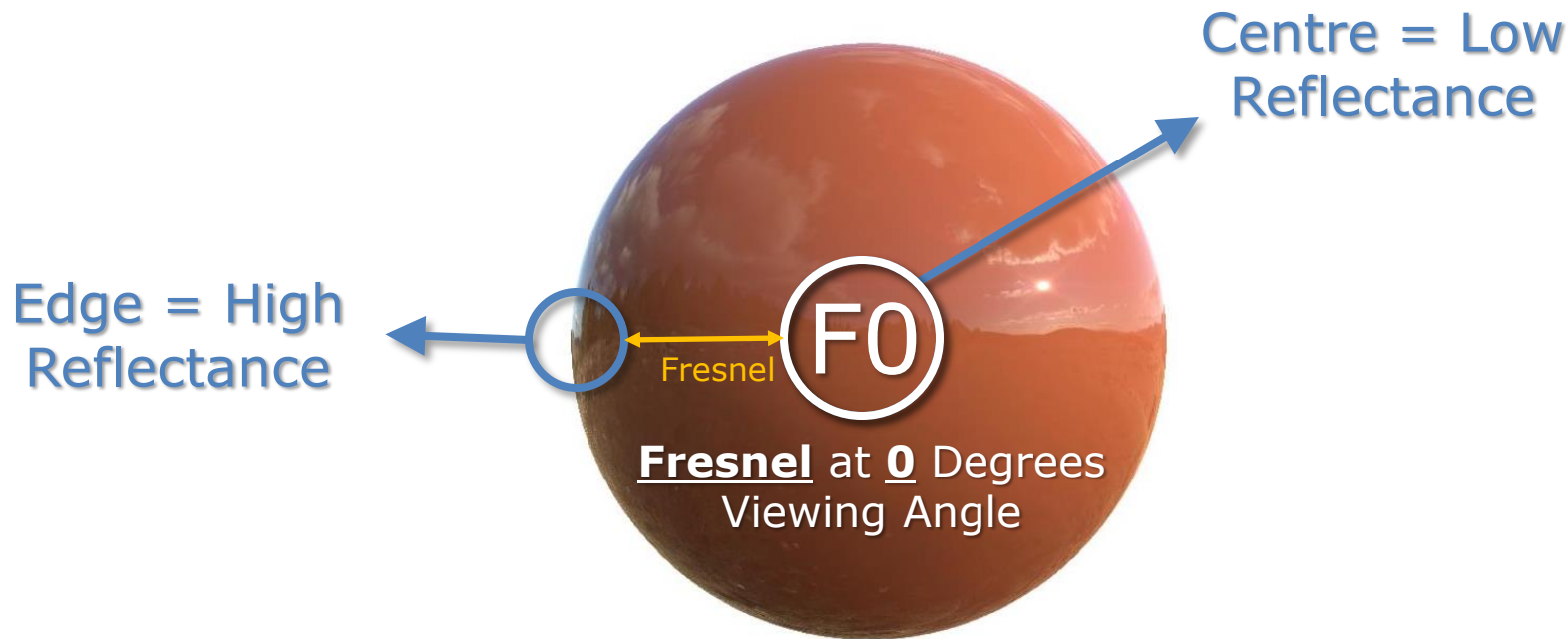


Not all surfaces are perfectly smooth!



Microfacet Theory

Measuring Reflectance



A smooth, dielectric surface

Enforcing the physics

Light reflected off a surface will never be brighter than the light that fell upon it.



Incoming Light

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Outgoing Light

Enforcing the physics

Energy Conservation



Incoming Light



Outgoing Light



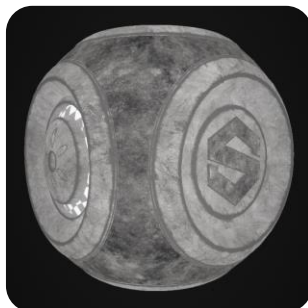
2. Authoring Workflow & Guidelines



Metallic Workflow



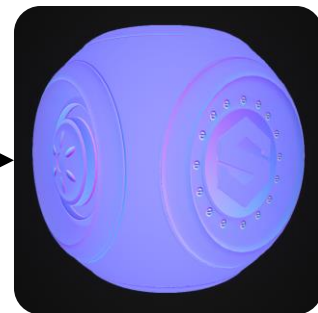
Base Color



Roughness



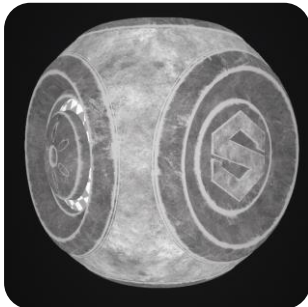
Metallic

*Normal*

Specular Workflow



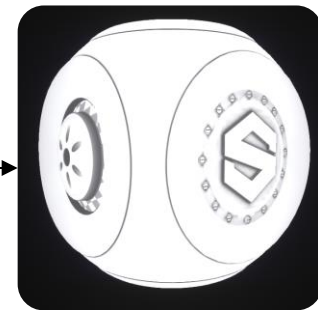
Diffuse



Glossiness



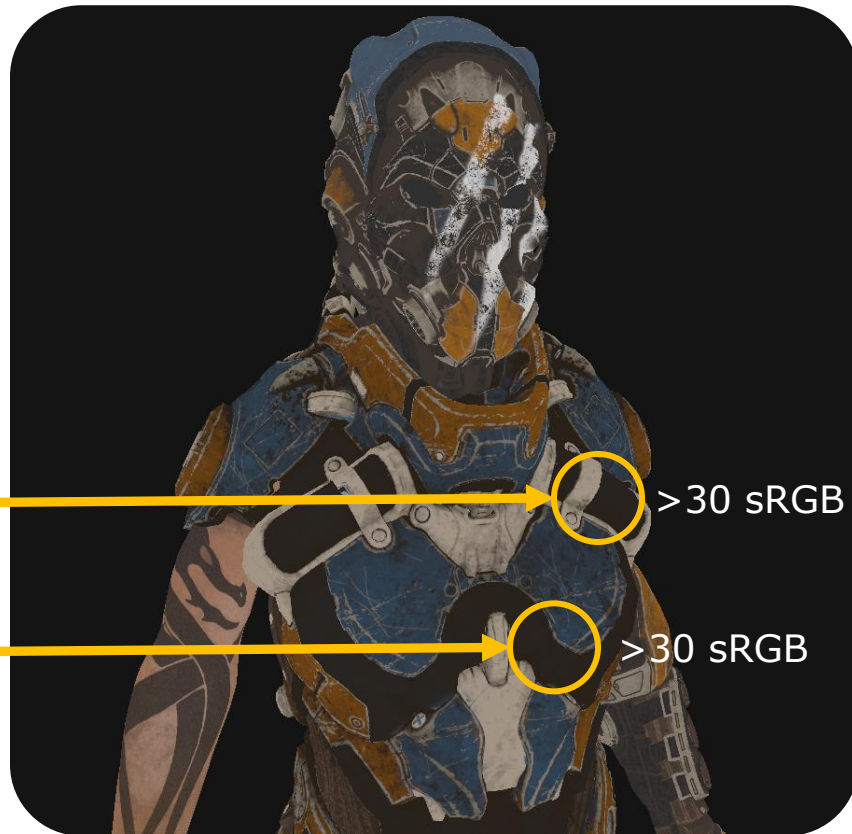
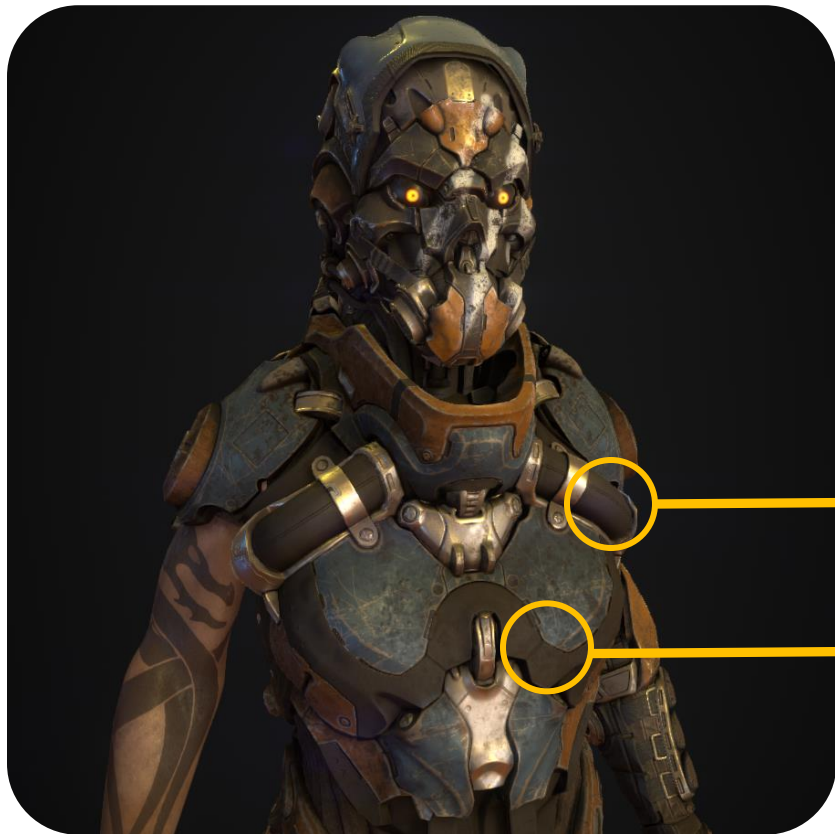
Specular

*Ambient Occlusion*

Base Color (Albedo)

- Devoid of lighting information
 - *exception micro-occlusion
- No dark values below 30 sRGB
(50 sRGB – strict mode)
- No bright values above 240 sRGB



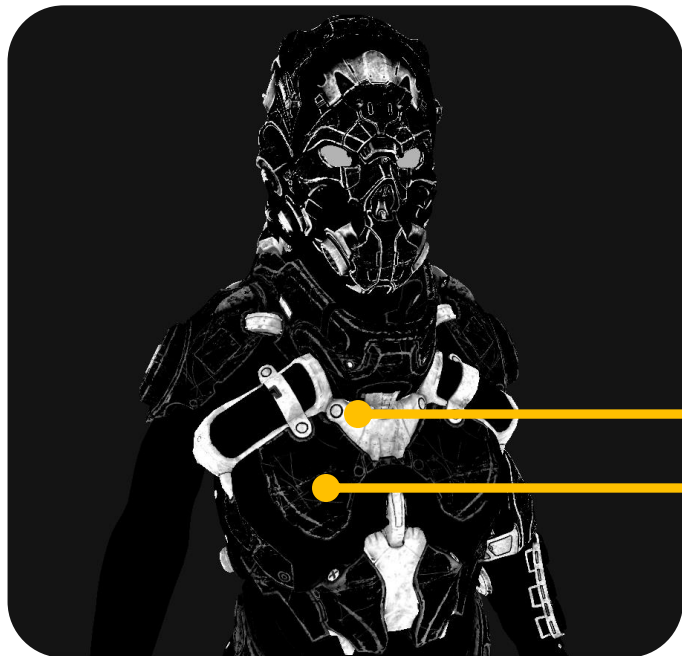


Character model created by Michael Pavlovich

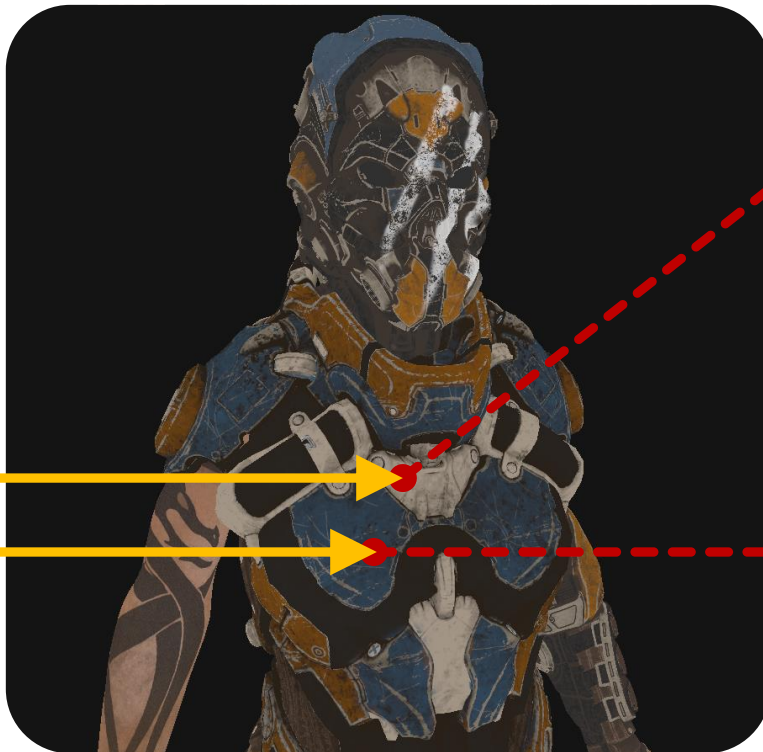
Metal Reflectance Values Base Color & Metallic

- 70-100% specular (180-255 sRGB)
- Some metals can be corroded
- Painted or coated metal is dielectric
- Dielectric layer affects metallic map
examples: dirt and rust





Metallic



Base Color

Titanium
sRGB (93,186,177)

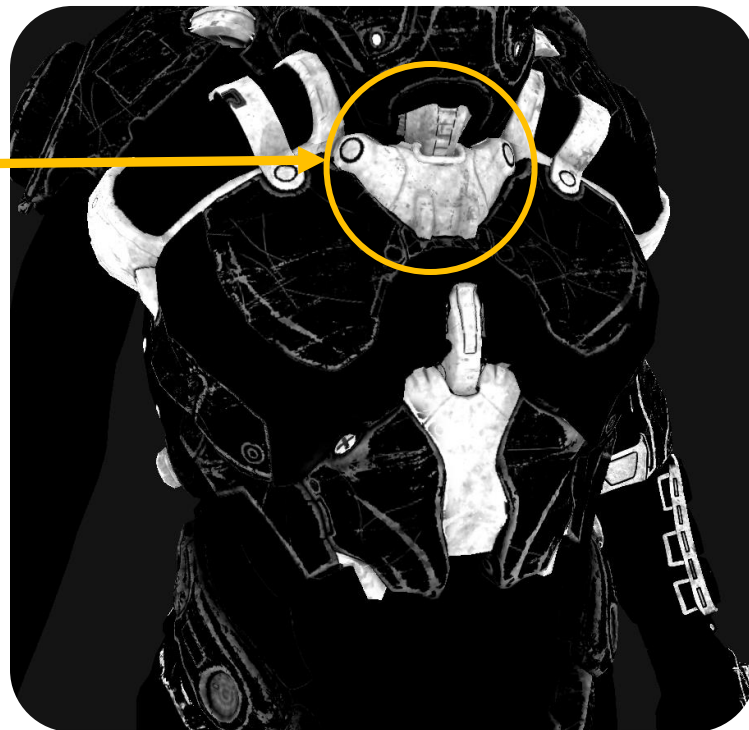
Metal Reflectance
Value
70 - 100% Specular



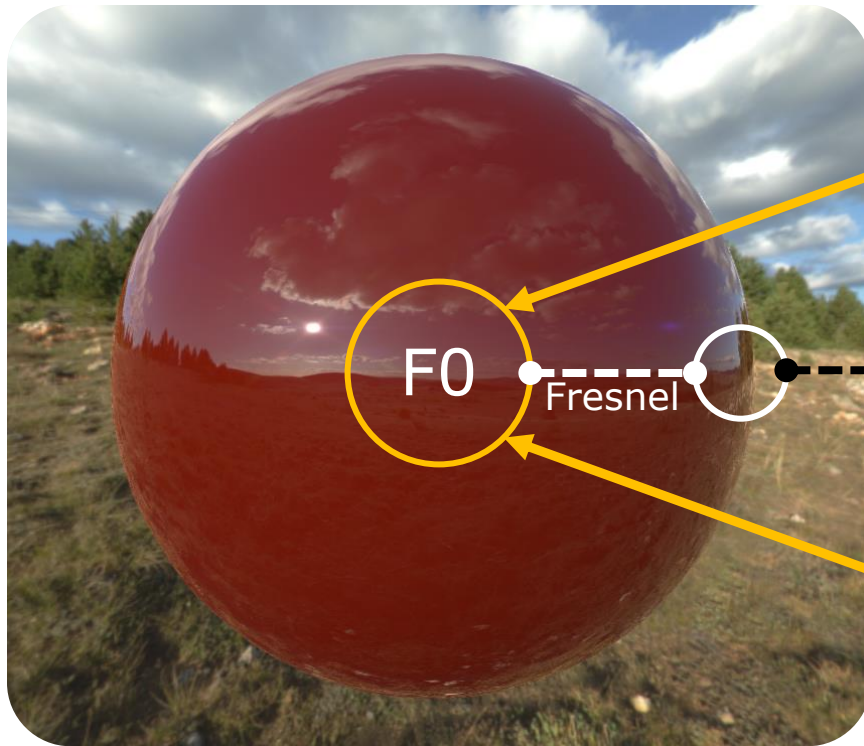
Diffuse Reflected
Color



Dirt layer on metal



Metallic



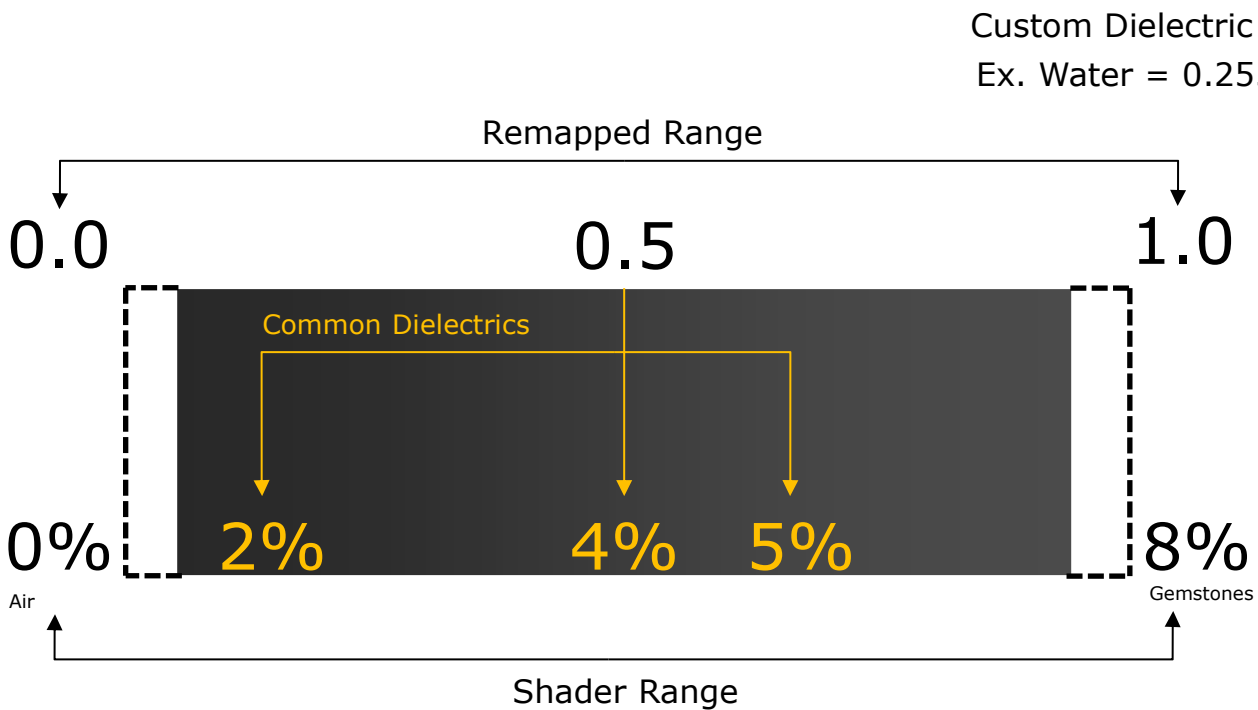
F0 (Fresnel 0 Angle)

2-5% Reflective

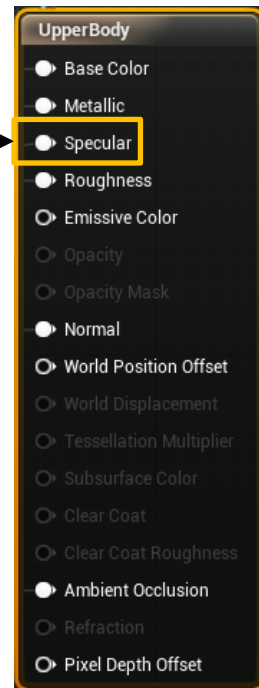
Common dielectrics ex. wood,
concrete, plastic

100% Reflective at
grazing angle

Plastic
sRGB(59,59,59)



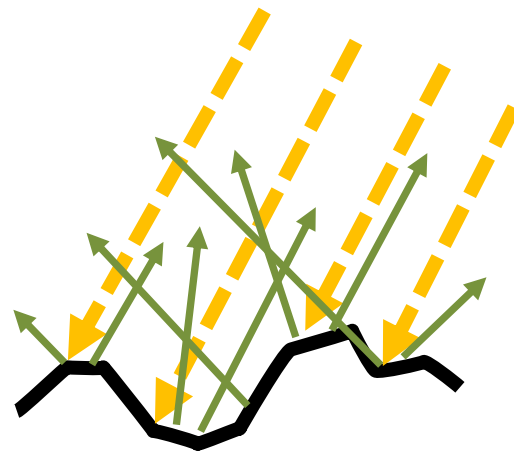
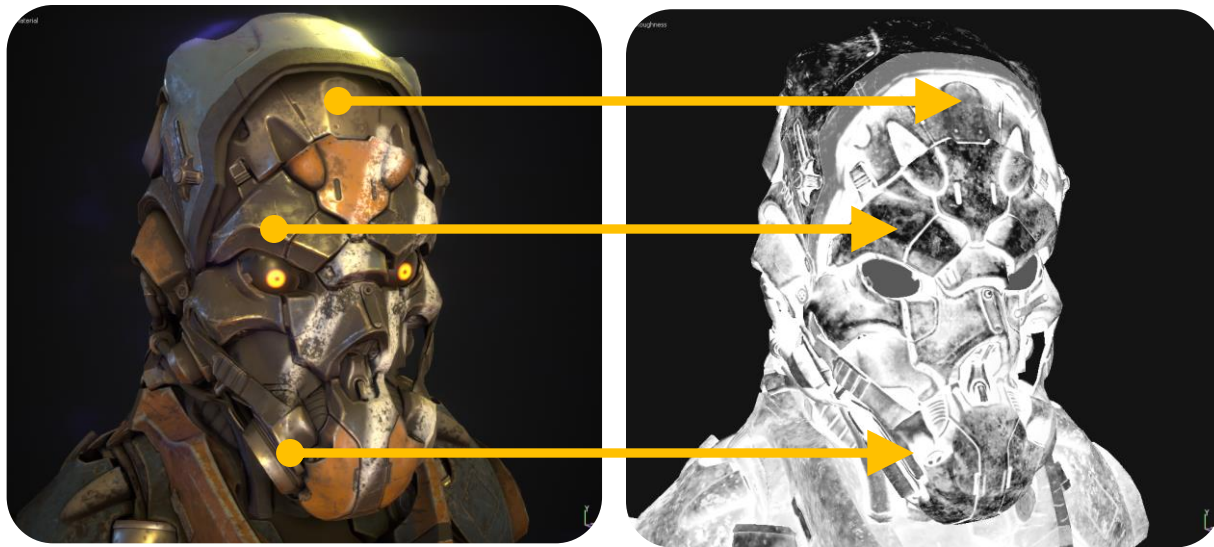
Custom Dielectric IOR
Ex. Water = 0.255



Roughness (micro-surface)

Smooth

Rough





3. Troubleshooting Physically-Based Scenes



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Summary

1. Understanding PBR:

- Many great benefits to using PBR, but we must fully embrace it and its rules in order to truly get the best out of it.
- In order for us to do this, its crucial that we spend some time looking at the basic scientific theories and principles which underpin PBR, as the better our understanding is – the better our content will become.



Summary

2. Authoring Workflow & Guidelines:

- Base Color is devoid of lighting info and no dark values below 30 sRGB or bright values above 240 sRGB
- Metal reflectance is 70-100% specular (180-255 sRGB) and the metallic map values are mainly binary (black or white).
- The roughness map is the most creative map to author. You can't go wrong here. White = rough and black = smooth.



Summary

3. Troubleshooting Physically-Based Scenes

- PBR materials can often miss-direct us about the roots cause of issues in our scene
- When objects are not behaving as expected, investigate the material properties before adjusting other elements such as lighting or reflections.





4. Q&A – Thanks for your time! 😊